Geophysical Research Abstracts
Vol. 20, EGU2018-14983, 2018
EGU General Assembly 2018

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Petroleum modelling in the Laminaria High, Bonaparte Basin, North West Shelf of Australia: Influence of critical stressed faults on hydrocarbon migration and leakage.

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Abstract
Modelling of hydrocarbon migration is essential for risk assessment in areas that show hydrocarbon leakage. Further understanding and modelling of the geological structures and reservoir properties that are associated with known leakage will increase the confidence of successful drilling. In addition, it helps to understand the possible reasons that lead to hydrocarbon leakage in these areas. Geophysical and geological evidences for hydrocarbon leakage associated with active faults on the Laminaria High, North West Shelf of Australia includes: 1) the presence of amplitude anomalies associated with the traces of faults that cut and displace the seabed reflector; and 2) the presence of residual hydrocarbons in dry, fault- bounded traps. We use Permedia software to model the possible secondary petroleum migration along a seismic reflection dip-line that crosses the area of interest. The models are used to investigate how the source rock properties and petrophysical characteristics of the sequence lithofacies influence the secondary migration. As there are large uncertainties associated with the entry pressures assigned to mapped faults, we start with the hypothesis that critically stress faults (identified based on their orientations and knowledge of the regional stress tensor) have lower entry pressures than other faults. We found that hydrocarbon migration is controlled by two major faults: 1) fault with strike direction NE dipping to the north; and 2) fault with strike direction NE dipping to the south. Hydrocarbons are more likely to migrate along faults in the southern part and less likely to migrate along faults in the northern part of the survey area. This is because the larger fault dipping to south has a larger slip tendency than the larger fault dipping to north; hence it will be more likely to leak. We conclude that vertical migration is controlled by faults that are critically stressed at the present day. These results are consistent with the geophysical evidence of hydrocarbon leakage at the seabed in the southern part.